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NOTES ON CERTAIN CLADONIAS.

BY BRUCE FINK AND MABEL A. HUSBAND.

PLATE VII.

The western hemisphere surpasses the eastern in number of *Cladonias* and in number of species peculiar to the hemisphere, hence the genus should have a special interest for the American student of lichens. While this is true, it remains a fact that our American descriptions of *Cladonias* have been, without exception, wholly inadequate and many of our determinations consequently incorrect. *Cladonias* are the most variable of all of our lichens and therefore the most difficult to describe definitely. Fortunately, the most variable characters are those which may be studied with the eye or with a good hand lens, and yet nothing but the most careful observation will enable one to determine a *Cladonia* with any degree of certainty even with the best descriptions. Size, form, color, lobing and branching and the presence or absence of cortex and soredia must be constantly kept in mind in the consideration of the horizontal thallus and yet more in the study of the podetia.

As to microscopic examination, it may be said that the spores, usually of considerable importance in determination, are here so constant in size and form that they may usually be neglected in descriptions. The same may be said of the algal cells. The so-called hypothallus is seldom seen and is of no use in the determination of *Cladonias*. Also those doubtful structures, the spermagones and the spermatia may be entirely neglected, while there is serious doubt as to the diagnostic value of chemical tests in the determination of any lichens. The minute anatomy of the thallus may yet be found to have some value in determination, but our investigations do not indicate that it is of sufficient importance to warrant adding to the necessarily long descriptions of such variable plants as the *Cladonias*.

With this short preliminary statement let us pass to the consideration of a few of the species; and we make no plea for beginning with the more conspicuous and better known *Cladonias*, for there is urgent need for careful study of every species. It is hoped that good descriptions of a few *Cladonias* may enable those interested in these plants to observe some characters usually quite overlooked. We have selected for description a number of *Cladonias* that are very commonly confused by American lichenists.

CLADONIA RANGIFERINA (L.) Web. in Wigger's Prin. Fl. Hols. 90. 1780.

Primary thallus rarely developed, when present crustaceous, delicate and composed of subglobose, depressed or irregular, clustered or scattered verrucae, which are .20–.40 mm. in diameter, ashy white and destitute of cortical layer. Podetia, without cortex, arising from the surface of the verrucae, or often as branches of old or dying podetia, or from free fragments

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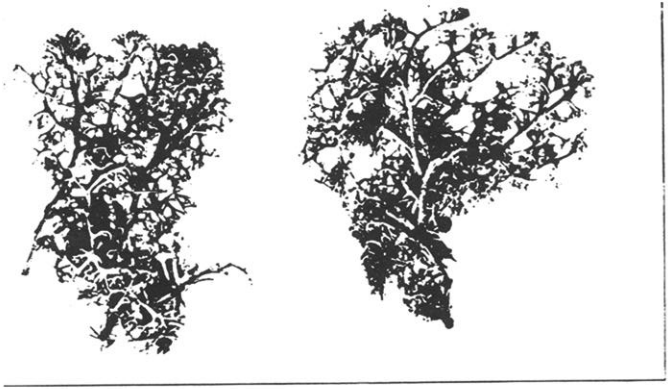
of old podetia, dying at the base and increasing in length at the top, 30–200 mm. long and .7–3 mm. in diameter, subcylindrical and cupless, subdichotomously or subradiately branched, the short branches usually unilaterally deflexed and their axils somewhat dilated and frequently perforate, erect or rarely ascending or even decumbent, clustered or often confusingly subsolitary among other lichens, grayish or grayish-brown, the apices subulate and furcellate, the sterile ones commonly nutant and often brownish. Apothecia small, .5–2 mm. in diameter, corymbose, solitary or clustered at the apices of the branches, immarginate, convex, the disk commonly brown. Hypothecium colorless or the sub-hymenial portion brownish. Hymenium brown above and pale-brownish below. Paraphyses usually simple, thickened at the pale or brownish apex. Asci cylindrico-clavate, the apical wall thickened. (Fig. 1.)

The plant grows on earth and over rocks covered by more or less humus. It also occurs in a degenerate condition on old wood. It is our largest *Cladonia*, single clusters being often three feet in diameter and standing a foot high in the most favorable habitats in northern regions. This lichen is known in nearly every part of all the continents.

CLADONIA SYLVATICA (L.) Hoffm. Deutschl. Fl. 114. 1796.

Primary thallus rarely developed, when present crustaceous, delicate and composed of subglobose scattered or clustered verrucae, which are .12–.48 mm. in diameter, straw-gold colored and destitute of a cortical layer. Podetia without cortex, commonly formed from branches of old or dying podetia or rarely arising from the verrucae of the primary thallus, dying at the base and increasing in length at the top, 30–150 mm. long and .5–4.5 mm. in diameter, cylindrical or subcylindrical, cupless, frequently somewhat dilated in the axils which are often perforate, dichotomously or finally sympodially or radiately branched, one or two radii becoming larger and erect, the others short and usually unilaterally or irregularly fasciculate and deflexed, the upper branches not much shortened and forming loose clusters, growing in dense clusters or subsolitary among other lichens and mosses, erect or rarely ascending or decumbent, often minutely webby-tomentose, whitish or yellow-straw-colored, or light sea-green, apices subulate and very minutely radiate or furcate spinous, the upper sterile ones often more or less nutant and especially these upper ones frequently brown or brownish. Apothecia small, .5–1.2 mm. in diameter, arranged in corymbs, solitary or clustered at the apices of the branches. having at first a very thin margin and finally immarginate, convex or depressed convex, the disk brown. Hypothecium almost colorless or the subhymenial portion brownish. Hymenium brownish above and pale or pale-brownish below. Paraphyses usually simple, somewhat thickened at the pale or brownish apex. Asci clavate with walls thickened at the apex. (Fig. 2).

This lichen grows with the last and is very closely related to it. The American and foreign distribution of the two is about the same, and they are found growing in the same clusters in a most confusing way. However, the first plant described is somewhat larger as a rule, the branching is



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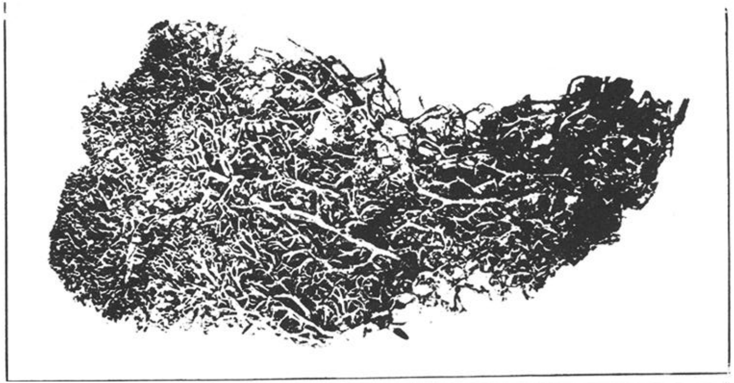

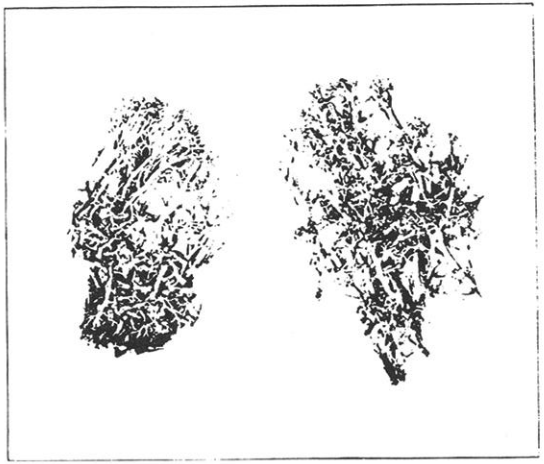

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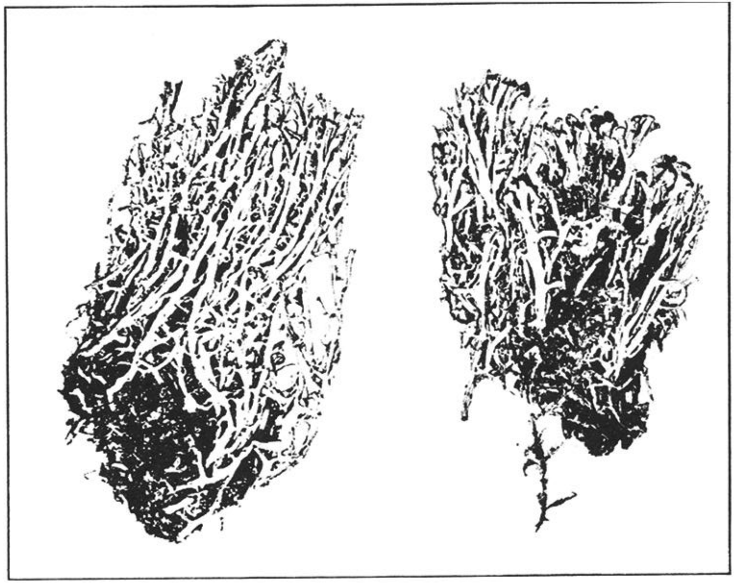

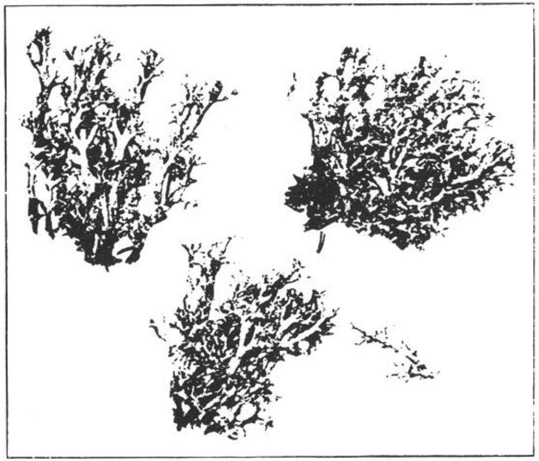

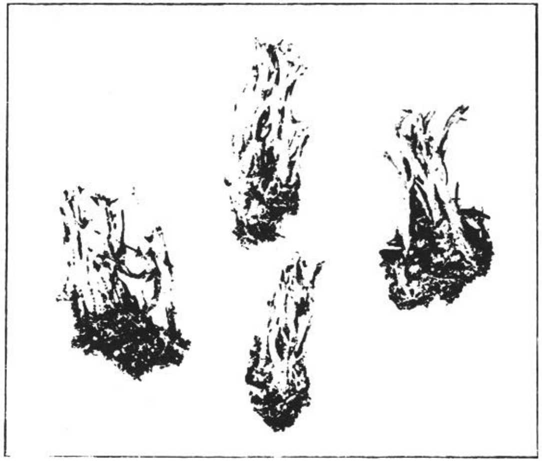

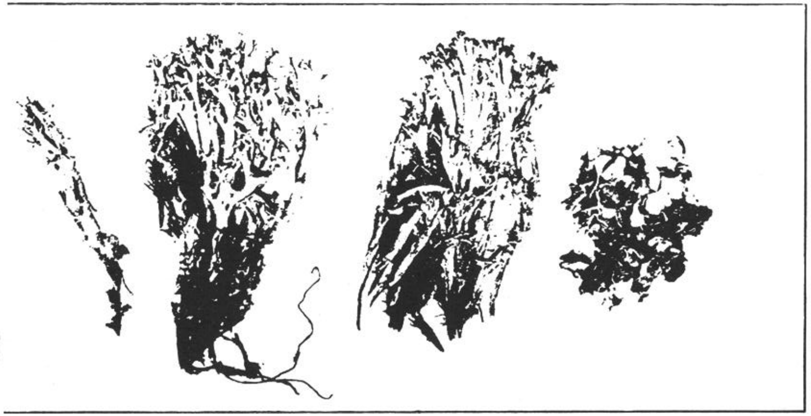

PLATE VII.

Fig. 1—Cladonia rangiferina. Fig. 2—C. sylvatica. Fig. 3—C. alpestris. Fig. 4—C. amaurocraea. Fig. 5—C. uncialis. Fig. 6—C. cenotea. Fig. 7—C. turgida.

The photographs are all from plants that have been seen by Dr. Wainio. Reduced one-quarter.

somewhat different, the tomentose condition scarcely marked, the color of the thallus on the whole duller and the spinous apices of the branches absent.

CLADONIA SYLVATICA (L.) Hoffm. var. LAXIUSCULA (Del.) Wainio Mon. Clad. Univ. **1**:29. 1887.

Podetia slender, quite long, abundantly dichotomously and sparingly radiately branched, the sterile apices nutant. Determined from Minnesota by Dr. Wainio. Apparently new to America and little known in Europe.

CLADONIA SYLVATICA (L.) Hoffm. var. SYLVESTRIS (Oed.) Wainio Mon. Clad. Univ. **1**:20. 1886.

The more tomentose condition, having rather more slender podetia and the apices of the branches more inclined to be straight.

This variety was determined for us from Minnesota by Dr. E. Wainio. It is doubtless widely distributed in America, though it has seldom been distinguished from the usual form of the species. Dr. Wainio has also given us the name CLADONIA SYLVATICA (L.) Hoffm. var. PUMILA (Ach.) Del. in Dub. Bot. Gall. 621. 1830, but the plant seems to be simply a small form of the above variety.

CLADONIA ALPESTRIS (L.) Rabenh. Clad. Eur. Exsic. 11. 1860.

Primary thallus rarely developed, when present crustaceous, delicate and consisting of subglobose or irregular, clustered or scattered verrucae, which are .16-.28 mm. in diameter, straw-colored and destitute of a cortical layer. Podetia arising from the verrucae of the primary thallus or often from old or dying podetia or from free fragments of dying podetia, dying at the base and increasing in length at the top, 50-200 mm. long and .5-2.5 mm. in diameter, subcylindrical, often somewhat dilated in the axils, cupless, subdichotomously or more commonly radiately or fasciculately branched, frequently from four to six branches surrounding a perforation in the axil, one or more branches becoming erect and larger, the others remaining short and becoming finally unilaterally fasciculate and deflexed, the upper branches shorter and forming dense thryses, cæspitosely clustered, erect, without cortex and more or less webby-tomentose, whitish or yellowish straw-colored, the apices subulate and frequently spinous, more commonly straight and sometimes colored brown. Apothecia small, .3-.5 mm. in diameter, disposed in dense corymbs at the apices of the branches, solitary, clustered or confluent, at first thin margined, finally immarginate, convex, the disk brown (or brick-red?). Hypothecium pale or pale brownish. Hymenium brownish above and pale below. Paraphyses simple or rarely branched, sometimes enlarged toward the apex. Asci clavate to cylindrico-clavate, the apical wall thickened. (Fig. 3).

Occurs with the two species above described, frequently intermingled in the same clusters and is more beautiful in color, delicacy of branching and arrangement of clusters than either of them. The three lichens are very closely related, and only the most careful study will enable one to distinguish the best marked forms, to say nothing of a multiplicity of intermediate conditions. The usual absence of the primary thallus and the peculiar origin of what may be call secondary podetia from other podetia, the dying away at the base and the frequent great luxuriance are characters common to the three species. The last one, like the other two, has a wide American and foreign distribution, but it is more confined to cold regions than the first two.

CLADONIA AMAUROCRAEA (L.) Schaer. Lich. Hely. 34. 1823.

Primary thallus usually disappearing early, composed of small usually ascending squamules, which are .5–1.7 mm. long and .16–.29 mm. wide, crenate or digitate-incised scattered or clustered, sea-green above and whitish below and covered by a continuous cortical layer. Podetia usually arising from old podetia, from free fragments of old podetia or rarely from the surface of the primary thallus, dying at the base and increasing in length at the top, 15–120 mm. long and .5–3 mm. in diameter, cupless and subcylindrical or more rarely cup-bearing, dichotomously, radiately or rarely irregularly or fasciculately branched, the axils closed or rarely perforate, branches spreading, the apices tapering and subulate and terminated by spines, cymose branchlets or cups, forming larger or smaller clusters, erect ascending or decumbent with straight apices, having a continuous or areolate cortex, without squamules or sparcely squamulose toward the base, straw-colored to sea green or rarely whitish between the areoles of the cortex, usually brownish toward the apices, the basal dead portions frequently of a darker color. Cups quite abruptly dilated and becoming 5 mm. in diameter, perforate or imperforate, frequently oblique, the margin finally spinous or radiately proliferous. Apothecia of medium size, .7–3 mm. in diameter, solitary or clustered at the apices of the branches, thinly margined or at length immarginate, plane or convex, sometimes perforate and lobed, the disk pale to brown (or even brick-red?). Hypothecium pale. Hymenium brownish above and pale or yellowish below. Paraphyses simple or rarely branched and scarcely thickened at the pale or brownish apex. Asci cylindrico-clavate, the apical wall thickened. (Fig. 4

Common in the extreme northern portion of the United States and Canada, but found further south only in the mountains. Grows on earth and on rocks covered by humus. Also widely distributed in foreign lands, but confined to cold regions. The plant is frequently confused with forms of *Cladonia furcata* and yet more frequently with the next below.

CLADONIA UNCIALIS (L.) Web in Wigger's Prim. Fl. Hols. 90. 1780.

Primary thallus usually disappearing early, composed of small, usually ascending squamules, which are .5–1 mm. long and .08–.15 mm. wide, crenate or incised-crenate, clustered or scattered, sea-green to straw-colored above and whitish below, having a continuous cortical layer. Podetia usually arising from old or dying branches or fragments of podetia or rarely from the margin of the primary thallus, dying at the base and increasing in length at the top, 25–100 mm. long and 1–3.5 mm. in diameter, cupless and subcylindrical, sometimes slightly dilated in the axils, dichotomously, sympodially or radiately branched, branches all elongated or some of them short and all more or less spreading, erect, ascending or decumbent, axils frequently perforate and the sides of the podetia also rarely perforate, cortex subcontinuous or areolate, the areoles smooth or somewhat raised, destitute of squamules, straw-colored to sea-green or the decorticate portions between the areoles white, the dead portion below frequently darker, the apices subulate and straight and frequently spinous and not infrequently brownish. Apothecia small, .5–.9 mm. in diameter, solitary or clustered at the ends of short radiately or cymosely arranged apices, thinly margined or without margin, plane or somewhat convex, the disk pale to brown. Hypothecium pale or colorless. Hymenium brownish above and pale or pale-brownish below. Paraphyses simple, rarely cohering, the pale apices very slightly thickened. Asci clavate or cylindrico-clavate, the apical wall thickened. (Fig. 5).

Grows on earth or on rocks covered by humus. The plant is found in all parts of North America and is quite cosmopolitan in its foreign distribution also. The species is usually a shorter plant than the last with rather stouter podetia, whose apices are rather more obtuse. Yet in northern regions where both species occur, the shorter cupless conditions of the last frequently seem to pass into the present species.

CLADONIA UNCIALIS (L.) Web. var. OBTUSATA (Ach.) Nyl. Syn. Meth. Lich. 215. 1860.

The plant of Acharius was of the usual size with minute axilary perforations, was densely radiate-branched and had obtuse more or less spinous summits. Ours from Oak Island, Lake of the Woods, and determined by Dr. Wainio, is a stout plant, the podetia reaching 3 or 4 mm. in diameter. The axilliary perforations are by no means minute, and the summits of the branches are scarcely spinous, though quite obtuse. The podetia reach 65 mm. in length. The specimen is well supplied with small apothecia and seems very near *Cladonia Boryi*, Tuck. Known in Europe, but not previously reported from America so far as we know. Perhaps *Cladonia uncialis* (L.) Web var. *turgescens* (Schaer.) Del. in Dub. Bot. Gall. 620. 1830, and *Cladonia uncialis* (L.) Web. var. *dilacerata* Leight. Not. Lich. Richards, 191. 1866, should be noticed as both have been reported from North America.

CLADONIA CENOTEA (Ach.) Schaer. Lich. Helv. 35. 1823.

Primary thallus persistent or finally disappearing, composed of middling sized, irregularly or subdigitately incised, more or less ascending, flat or involute, clustered or scattered squamules, which are whitish, sea-green, brownish or olivaceous, 1–3.5 mm. long and .10–.30 mm. wide. Podetia arising from the surface of the primary thallus, sometimes dying at the base but slowly increasing in length at the top, 10–85 mm. long and .5–4 mm. in diameter, cylindrical, turbinate or irregularly turgescent, commonly erect, cup-bearing, decorticate and sorediate or corticate toward the base, without squamules or squamulose toward the base, white, ashy, sea-green or brownish or these colors variegated, the lower dead portion ususally darker, the sides and the apices usually perforate. Cups 2–8 mm. in diameter, commonly perforate, becoming repeatedly proliferate. Apothecia small, and rare in ours, .5–1.5 mm. in diameter, subsolitary or more or less clustered on the margins of the cups or at the apices of the branches, most commonly immarginate, plane to convex, often perforate, the disk flesh-colored to brown. Hypothecium pale or pale-brownish. Hymenium brownish or pale above and pale or pale-brownish below. Paraphyses often thickened and sometimes branched toward the pale apex. Asci clavate, the apical wall thickened, commonly containing six spores. (Fig. 6).

Grows on earth or old wood, and in the western hemisphere is confined to the northern half of North America, including the extreme northern part of the United States. Common to all the grand divisions of the eastern hemisphere. Certain conditions are sometimes confused with the last species, but more commonly with the next below. Dr. Wainio has referred one of Tuckerman's specimens, (Tuck. Lich. Amer. Exsic. no. 125. 1854) to *Cladonia cenotea* (Ach.) Schaer. var. *crossota* (Ach.) Nyl. Lich. Scand. 57. 1861, and gives description, which in absence of specimen conveys no distinct idea.

CLADONIA TURGIDA (Ehrh.) Hoffm. Deutschl. Fl. 124. 1796.

Primary thallus persistent or finally disappearing, composed of large foliose squamules, which are irregularly or subdichotomously lobate or laciniate, erect or ascending, plane, convex or convex and involute, often closely clustered, whitish to pale sea-green above and white below, having a continuous cortex, 5–20 mm. long and 2–5 mm. wide. Podetia arising one or more from the surface of any squamule of the primary thallus, sometimes dying at the base and rarely increasing in length at the top, 20–75 mm. long and 1.5–3.5 mm. in diameter, turgescent and turbinate or subcylindrical, sometimes rather obsoletely cup-bearing, radiately or dichotomously branched, the branches erect or spreading, axils and also the sides frequently perforate or even gaping, erect or ascending, cortex subcontinuous or areolate, sometimes more or less squamulose, whitish to whitish-sea-green or the decorticate portions between the areoles white, the basal dead portion sometimes becoming brown, the cupless apices obtuse or shortly radiate or furcate and frequently becoming brown. Cups slightly dilated, perforate or closed and rarely cribrose, the margin radiate-proliferous. Apothecia small or middling sized, .5–2 mm. in diameter, solitary or clustered at the ends of the branches and frequently short stipitate, thinly margined or immarginate, plane or convex, often lobed and perforate, the disk brown (or brick-red?). Hppothecium pale or pale-brownish. Hymenium pale brown above and pale or pale-brownish below. Paraphyses somewhat clavate toward the pale or brownish apex. Asci cylindrical to clavate, the apical wall thickened. (Fig. 7).

Occurs on earth or on rocks covered with humus. Known in the northern part of North America and in northern Europe and extending further south in mountains. Found in northern United States as well as further north. Easily confused with either of the last two plants. *Cladonia turgida* (Ehrh.) Hoffm. var. *grypea* Tuck. Enum. Lich. in Agass. Lake Super, 173. 1850 may be distinct. This variety is described in Tuckerman's

Synopsis under the name, *Cladonia turgida* (Ehrh.) Hoffm. var. *conspicua* (Schaer.) Nyl. Addit: Fl. Chil. 147. 1855. The primary thallus is usually wanting, the podetia elongated and sometimes quite squamulose.

In closing some explanation of a few expressions used above will be helpful. Our sea-green is a grayish green or perhaps nearer a gray than a green. Single cells or hyphae which are hyaline, when seen collectively as in an hymenium or an hypothecium, are of a whitish color, which we have called pale. Paraphyses of *Cladonias* are hyaline except at the tips.

Even water will sometimes causes the coloring matter of the epithecium to diffuse through the hymenium, especially the upper portion, in sections. To avoid error from this source. sections must be examined as to color the moment after cutting.

Fayette, Iowa.

HEPATICS—LEJEUNEA.

William C. Barbour.

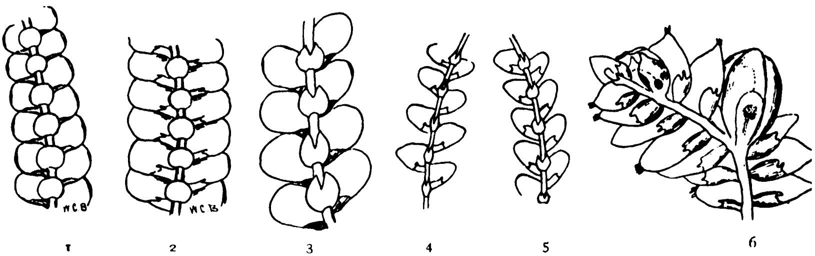

Fig. 1. Archilejeunea clypeata Fig. 2. A. Sellowiana Fig. 3. Lejeunea Americana Fig. 4. Microlejeunea lucens Fig. 5. M. Ruthii Fig. 6. Cololejeunea Jooriana

The genus *Lejeunea* was founded by Libert, and as such was accepted by Spruce and many other writers. If considered as a single genus it is a very large one, and was divided by Spruce into thirty-seven subgenera. Most of these were raised to the rank of genera by Schiffner when, in 1893, he issued the Hepatic part of Engler and Prantl's Natur Pflanzenfamilien.

We shall endeavor to adapt from older works a description of the genus which shall cover the composite Lejeunea as covering all these divisions. The descriptions of species are adapted and simplified from the monograph by A. W. Evans, of Yale University, published in Volume VIII., No. 2, Memoirs of the Torrey Botanical Club. Most of the illustrations were redrawn from the same source. Dr. Evans admits to the flora of the United States and Canada twenty-three species, of which about ten occur in the "Gray's Manual Region."

Of the thirteen species not here included, seven are found in various States of the South, including Florida; five in Florida only: and one, *Colelejeunea Macounii* (Spruce) Evans, occurs in British Columbia. Of the species here noted, one, *Lejeunea patens* Lindb. is found in Newfoundland and Nova Scotia. The other occurs at various points in the Northeastern States.

In temperate regions the number of species found is comparatively small, while in the tropics the genus reaches proportions which are alarm-